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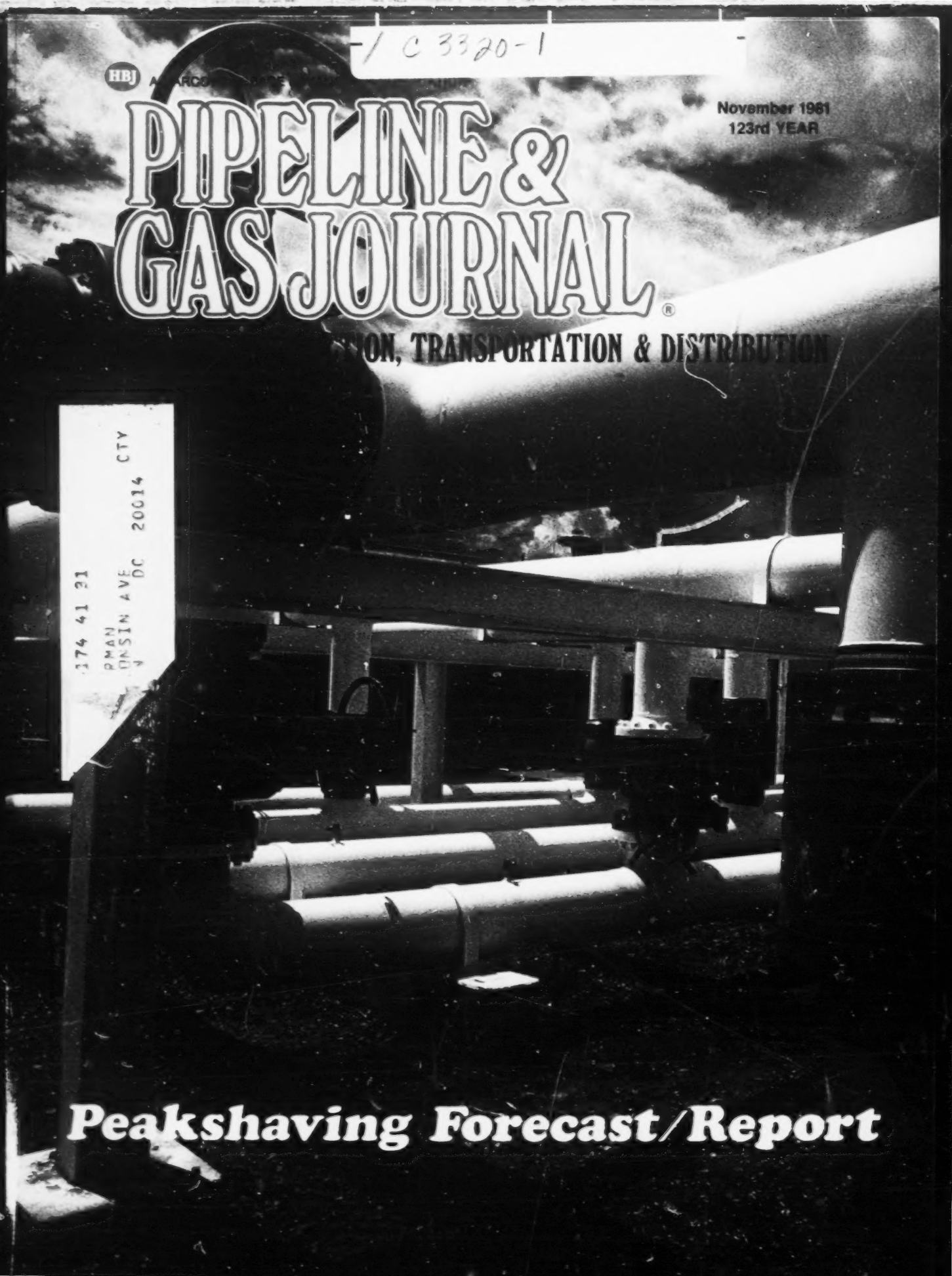

Peakshaving Forecast/Report

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COVER

Storage facility piping characterizes the peakshaving aspects of the gas industry, which must rely heavily on underground gas storage, propane-air plants, LNG peakshaving facilities, and related operations to meet wintertime's high demands.

—Photograph courtesy Montana Dakota Utilities Company

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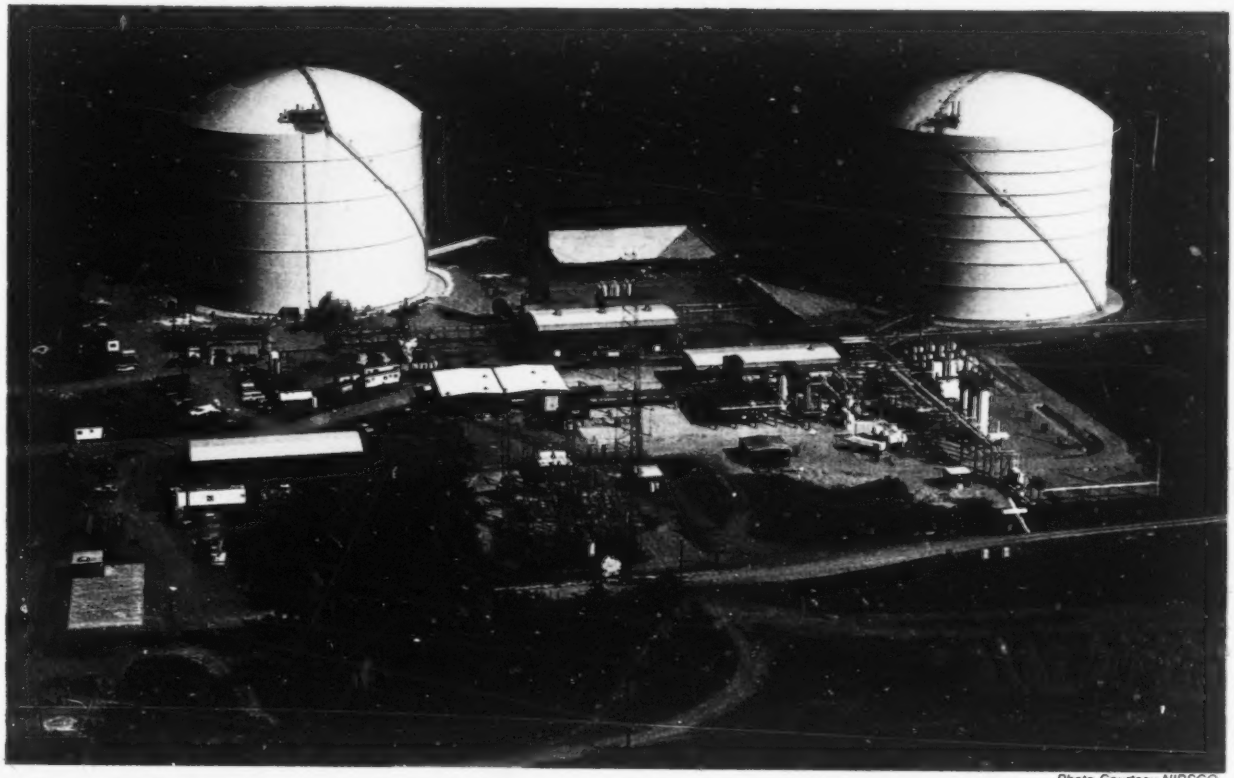


Photo Courtesy NIPSCO

Total capacity of Northern Indiana Public Service Co.'s LNG peakshaving plant at La Porte, Indiana, has been increased to an equivalent 4 billion cu ft with addition of a second tank, shown here at left. New tank has capacity of 2 billion cu ft equivalent (580,000 bbl) and was built by Chicago Bridge & Iron Co. Regasification capacity was also doubled and plant sendout is now a total of 400 million cu ft per day. Lotepro was contractor for the plant.

'81-'82 Peakshaving Capacity Is Gas Industry's Best Ever

by Dean Hale, *Editor*

America's natural gas industry continues to build its capacity to provide peakshaving gas supplies to meet expanded heating season needs of its more than 48.5 million gas customers during the 1981-82 winter.

With some 39 million gas customers heating their homes with natural gas, it is essential to have adequate supplies from both contract and supplemental sources to insure continued service despite blizzards, blue northers, and extended cold spells.

PIPELINE & GAS JOURNAL's latest annual peakshaving survey indicates that the gas industry will have a capacity of 72.87 billion cu ft maximum delivery from all of its various peakshaving gas sources in a single 24-hr period. Adding to that an estimated 66.2 billion cu ft of regularly scheduled deliveries produces a projected maximum delivery in one day that could reach 139.1 billion cu ft – not likely to be needed at one time as the entire nation seldom experiences a major, nation-wide cold spell in all of the 48 contiguous states at the same time.

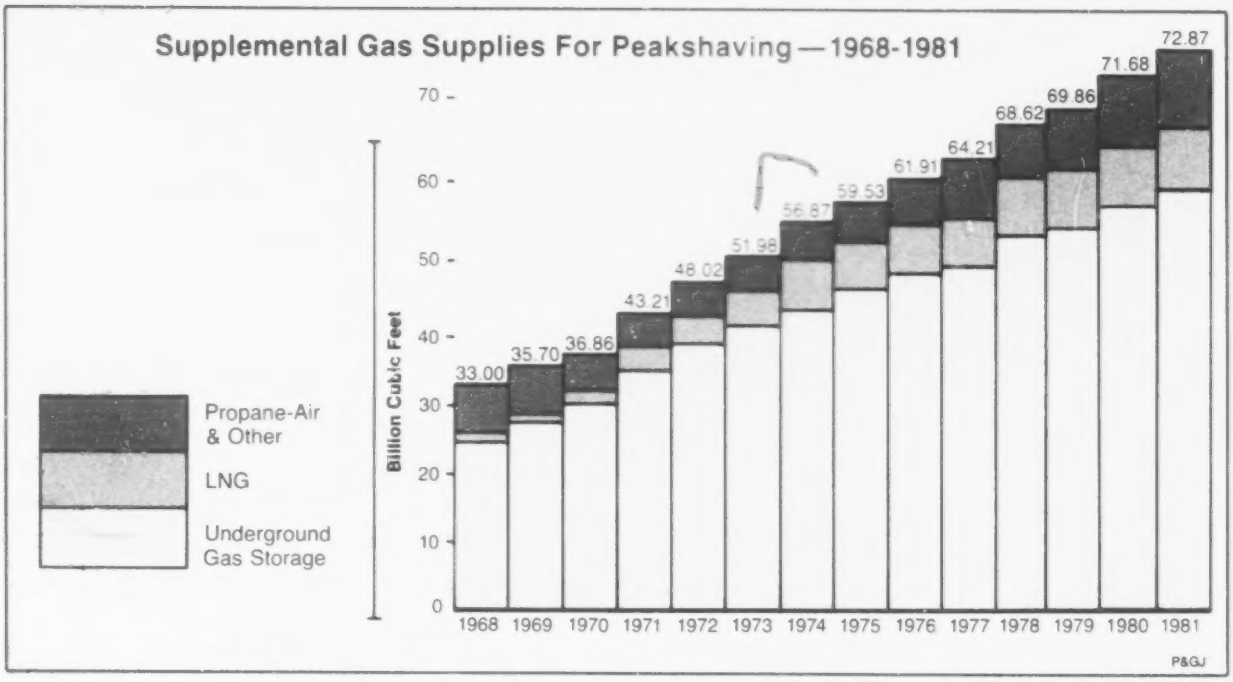
For the 1981-82 winter, the industry's top peak-day sendout total is expected to range from 80 to 88 billion cu ft in a single 24-hr period.

For some areas of the nation, particularly in the north central and northeastern states, supplemental gas supplies will be required to provide a substantial part of the gas demand at any one time during the winter season.

For the 1981-1982 winter season, peakshaving supplies will include:

58.40 Bcf from underground gas storage
5.21 Bcf from propane-air plants
8.99 Bcf from LNG peakshaving and satellite plants
0.27 Bcf from other sources

The increase in deliverability – 1.239 Bcf – from underground gas storage facilities continues a trend of recent years in which gas storage is assuming an increasingly important role in gas supply operations. Deliverability from LNG peakshaving plants continues to be static – no significant new LNG projects were added in 1981 – and operators of existing plants continue to "fine tune" them to obtain slight increases in deliverability. Propane-air plant additions tapered off in 1981 as utilities attempted to match customer demands with system supplies. The "other" sources include sendout from SNG plants operated for peakshaving purposes (making high Btu gas from naphtha and other hydrocarbons). Cost of the petroleum feedstocks skyrocketed in 1980 and the plants are operated only if absolutely necessary. Other sources also



include line pack, buried bottle-type storage, gas holders (few remain in the U.S.), and enrichment of gas stream by direct injection of propane or ethane to boost Btu content.

Underground Gas Storage

The search for underground gas storage continues as companies seek tight caverns, abandoned oil and gas fields, and aquifers for containment of gas supplies nearer to the markets – or at least intermediate between production areas and markets.

Developing new storage facilities – drilling and completing injection and withdrawal wells, observation wells, installing field lines, and installing compressor horsepower and related measurement, filtering, dehydrating, and odorization equipment and control systems and communications systems – required an investment of $314,800,000 during 1981 (compared to $352,240,000 in 1980), and for 1982, an estimated $286 million will be spent for new facilities and field development. This projection does not include projects not yet announced.

As of Nov. 1, 1981, there were 404 gas storage fields being operated or developed by 92 companies, including 392 fields that are considered active, another 12 under development or planned.

Maximum deliverability of the 392 active fields is estimated at 58.403 Bcf per day in a 24-hr period, according to PIPELINE & GAS JOURNAL's peakshaving survey data.

At the 404 operating and under-development gas storage fields, current data indicates there are 18,065 wells (a net increase of 170 over 1980); 6820 miles of field lines (up 79 miles over 1980's total), and a net gain of three compressor stations with a net increase of 60,596 hp for the year.

Current gas storage developments include:

Western Slope Gas Co. has completed its Roundup gas storage field in Morgan County, Colo., which is expected to provide up to 50 MMcf of gas per day when full operation is assumed. Field has a working capacity of 4,200 MMcf and total capacity of 11,400 MMcf.

Southeast Michigan Gas Co. has completed its Collin gas storage field in St. Clair County, with a working capacity of 1,500 MMcf; total capacity of 2,460 MMcf; and an estimated design deliverability of 25 MMcf per day.

El Paso Natural Gas Co. plans to be able to make withdrawals during the 1982-1983 winter season from its Washington Ranch field in Eddy County, N. M. The field has a design deliverability of 400 MMcf per day.

Southern California Gas Co., Pacific Lighting Service Co., and Pacific Gas & Electric Co. are in the second year of jointly developing the Ten Section Field, near Bakersfield, as a giant gas storage facility. The depleted oil field, with facilities costing $195.5 million, will have a 50 Bcf working capacity. SoCalGas and PG&E will each own 50%. The field is also expected to produce another 5.6 million bbl of oil as a result of the gas injection and withdrawal. Work on the first stage of the project is scheduled for completion in April 1982. Final completion is scheduled for 1984.

Pataya Storage Co., Las Vegas, Nev., is awaiting FERC approval to use a salt cavern in northern Mohave County of Arizona for gas storage. The salt body, 12 miles long by 5 miles wide by 2 miles thick, is to be excavated by solution mining technique. Cost of the project is estimated at nearly $43 million. Storage area is some 30 miles from El Paso Natural Gas Co.'s main transmission system and EPNG would utilize the storage cavern.

Arkansas Louisiana Gas Co. has completed construction of its Chiles Dome Field in Oklahoma and has been injecting gas in contemplation of withdrawals from the field for the 1981-1982 season.

Valero Gas Storage Co. plans to sell and lease back its gas storage facilities in Wharton County, Tex. Valero will receive some $55 million from the sale of four caverns to ML Caverns Inc. and GATX Storage Services Inc. Two of the caverns, costing $36.2 million, are covered in the initial transaction. Two more caverns, currently being mined, will be completed in 1982. Injection of gas into the first two caverns was completed in October and Valero expects to make some withdrawals in the 1981-1982 season.

Minnesota Gas Co. is proceeding on schedule in developing a second storage field in southern Minnesota, near Wells, about midway between the state's east-west boundaries. Work has been underway at the site since 1976. A 90-day water pumping test, completed in 1980, indicated positive reservoir data. Storage depths are expected to be about 1200 ft. Capacity estimates vary, but potential could be as high as 50 Bcf.

Mississippi River Transmission Corp. plans to spend $2

U.S. Underground Gas Storage Operations — Operating Companies — 1981 Data

Company	No. of Fields	No. of Wells	Miles Storage Lines	Storage Compressor Stations No.	HP
ANR Storage Co.	4	50	25.10	3	33,750
Arkansas Louisiana Gas, Co.	5	73	39.00	5	42,200
Arkansas Oklahoma Gas Corp.	1	12	3.00	1	370
Arkansas Western Gas Co.	4	12	3.72	4	1,175
Battle Creek Gas Co.	3	3	2.00	2	1,050
	— (1 under development) —				
Bear Creek Storage Co.	1	52	25.5	1	28,000
Brady, Tex., Municipal Gas Corp.	1	2	2.00	1	420
Cabot Corp.	2	13	14.60	2	2,395
Central Illinois Light Co.	2	86	21.27	2	4,265
Central Illinois Public Service	3	78	9.80	3	3,220
	— (1 under development) —				
Cities Service Gas Co.	10	589	164.00	6	29,800
Citizens Gas & Coke Utility	8	182	319.00	2	3,695
Colorado Interstate Gas Co.	4	122	230.00	3	9,700
Columbia Gas Transmission Corp.	49	3,685	1,208.10	27	108,625
Columbia Gas of Pennsylvania	1	8	3.43	1	900
Consolidated Gas Supply Owned	9	1,054	458.00	9	119,300
Joint	4	295	117.00	8	60,390
	13	1,349	575.00	17	179,690
Consumers Power Co.	11	477	128.66	4	78,810
Delhi Gas Pipeline Corp.	1	— (under development) —			
East Ohio Gas Co.	4	757	253.50	3	20,220
El Paso Natural Gas Co.	2	35	39.00	1	4,400
	— (1 under development) —				
Equitable Gas Co.	15	280	127.95	9	15,330
Felmont Oil Corp.	1	10	6.00	1	1,050
Egyptian Gas Storage Co.	2	3	—	—	—
Gas Utilities (Ill.)	1	4	3.10	—	—
Hampshire Gas Co.	1	13	17.00	1	1,640
Honeoye Storage Corp.	1	34	15.80	1	2,200
Hoosier Gas Corp.	3	24	8.30	0	—
Houston Pipe Line Co.	1	58	12.00	3	13,410
Illinois Power Co.	8	237	34.75	8	12,100
Indiana Gas Co.	7	290	104.78	4	2,845
Kane Gas Light & Heat Co.	1	21	10.00	1	60
Kansas Nebraska Natural Gas	4	34	23.40	3	5,530
Laclede Gas Co.	1	50	32.08	1	9,020
Lawrenceburg Gas Co.	1	1	—	—	—
Lone Star Gas Co.	12	112	78.58	11	24,835
Louisville Gas & Electric Co.	9	837	126.16	3	19,055
Michigan Consolidated Gas Co.	5	514	90.00	4	71,000
Michigan Gas Storage	3	554	166.10	1	30,900
Michigan Gas Utilities Co.	1	4	3.00	1	800
Michigan Wisconsin Pipe Line Co.	15	1,254	316.00	10	110,700
	— (1 under development) —				
Midwestern Gas Transmission Co.	3	55	11.70	2	1,593
Minnesota Gas Co.	2	40	15.00	1	2,200
	— (1 under development) —				
Mississippi River Transmission Corp.	3	66	72.06	3	22,050
Mississippi Valley Gas Co.	1	3	1.00	1	584
Montana-Dakota Utilities Co.	3	87	103.00	3	22,422
Montana Power Co.	4	39	38.00	3	5,960
Mountain Fuel Resources Inc.	1	26	15.50	1	28,400
Mountain Fuel Supply Co.	3	26	10.0	3	6,000
Mustang Fuel Corp.	1	1	4.00	—	—
National Fuel Gas Supply Corp. owned	30	951	486.80	14	237
joint	4	329	63.10	(4)	(39,900)
Total	34	1,280	549.90	14	237
	— (3 under development) —				
National Gas & Oil Corp.	3	31	8.00	3	1,950
National Zinc Co.	1	7	—	1	119
National Gas Pipeline Co. of America	13	850	305.00	8	119,040
North Penn Gas Co. owned	2	18	12.66	1	4,995
(joint	1)				
Northern Gas Co.	4	8	13.00	4	1,900
Northern Illinois Gas Co.	7	505	264.03	6	113,990
Northern Indiana Public Service	2	135	29.00	2	7,320
Northern Natural Gas Co.	3	306	185.80	2	21,160
Oklahoma Natural Gas Co.	4	60	22.00	2	11,200
Pacific Gas & Electric Co.	3	95	22.47	3	14,990
Panhandle Eastern Pipe Line Co.	5	241	114.00	5	19,680
Peoples Gas Light & Coke Co., The	1	137	189.00	1	14,900
Peoples Natural Gas Co.	11	86	37.00	12	10,720
T. W. Phillips Gas & Oil Co.	7	74	—	7	1,995
Phillips Petroleum Co.	3	6	22.00	2	620
Pioneer Natural Gas Co.	2	1	1.00	1	880
	— (1 under development) —				
Public Service Co. of Colorado	1	13	8.27	1	17,000
South Louisiana Production Co.	1	3	10.00	1	30
Southeastern Michigan Gas Co.	3	8	2.00	3	3,920
Southern Indiana Gas & Electric Co.	2	83	17.30	2	1,500
Southern Natural Gas Co.	1	72	48.22	1	21,750
Southern California Gas Co.	7	320	110.50	6	104,090
	— (1 under development) —				
Southwest Gas Corp.	1	— (under development) —			
Southern Union Co. (Gas Co. of New Mex.)	1	11	12.00	1	3,00
Southwest Gas Storage Co.	1	49	18.00	1	6,000
Southwestern Gas Pipeline, Inc.	2	11	3.45	1	440
Tennessee Gas Pipeline Co. (joint)	(5)	(406)	2.00	2	19,600
Texas Eastern Transmission Corp. owned	1	75	28.50	1	11,000
Texas Gas Transmission Corp.	10	457	217.26	11	19,765
Transcontinental Gas Pipe Line Corp. owned	3	57	22.45	3	46,100
(joint	2	181	79.00	2	34,300)
Trunkline Gas Co.	1	83	27.00	1	15,400
Union Gas System, Inc.	5	115	25.00	2	660
Union Light, Heat & Power Co.	1	25	28.00	—	—
United Gas Pipe Line Co. owned	1	19	6.10	1	2,550
joint	1	73	21.70	1	34,000
	2	92	27.80	2	36,550
Valero Gas Storage Co.	1	2	(under devel.)		8,000
Victor Gas Co.	1	6	12.00	2	300
Washington Natural Gas joint	1	77	9.90	1	12,500
Washington Water Power Co. Northwest Pipeline Corp.					
Western Kentucky Gas Co.	6	58	19.30	4	1,555
Western Slope Gas Co.	3	37	27.34	2	3,368

million on a three-year further development of its East and West Unionville Storage Fields in Lincoln Parish, La.

Propane-Air Plants

Activity in the addition of propane-air plant capacity slowed somewhat in 1981 as gas distribution utilities, looking at weakened housing demand and lowered gas demand, sought to match existing gas supplies with customer requirements. Even so, there was a slight gain – propane-air plants in the U.S. registered a gain of two (to a total of 503) and are operated by 242 gas utilities in 41 states. Deliverability of the facilities increased marginally to 5.21 Bcf per day total. An estimated 10 million gal. of additional propane storage was added at both new and existing propane-air plants during 1981.

LNG Peakshaving Developments

In the U.S., activities relating to the construction of new LNG peakshaving facilities show very little change from one year ago.

Northern Indiana Public Service Co.'s second LNG plant has been completed and is now on-stream, liquefying gas to meet this winter's heating season demands.

Southwest Gas Corp.'s H. G. Laub peakshaving plant construction at Dayton, Nev., continues to be on schedule. CBI's latest project, barring delays by regulatory agencies,

calls for a May 1982 mechanical completion of the plant. As noted, CBI has a turnkey contract for the facility.

Energy Terminal Services continues to process its application to convert the Staten Island Terminal site to a peakshaving facility. FERC issued its draft supplement to the final environmental impact statement covering the proposed change from an import terminal to a peakshaving facility. In summary, the draft supplement included evaluations of safety related aspects of the site and alternative sites for the facility.

From its analyses of vapor and radiation hazards for major LNG spills at the facility, FERC concluded that the hazard would normally be confined to the plant site. Under some conditions an LNG storage tank fire could cause high levels of radiation at nearby property lines, but the levels would still be less than the maximum permitted by MTB's regulations for new LNG facilities. The analysis of flammable vapor cloud hazards was hindered by lack of information about the final dimensions of the containment systems.

Nevertheless, preliminary results indicate that if an LNG transfer line failed at either the vaporizers or storage tank dikes, flammable vapors could drift offsite under adverse meteorological conditions. The proper application of subdikes, insulated containment surfaces, or vapor barriers will be required to eliminate this hazard, according to the Draft Supplement.

FERC also concluded that none of the alternative sites examined in New York City or New Jersey are significantly superior environmentally to the existing ETS site at Rossville. Furthermore, the time required to design, construct, and obtain the necessary permits for an entirely new facility would delay the project far behind the 1983 start-up of the present proposal. In addition, the staff noted that NYCFD regulations restricting LNG storage tank capacity and construction pose additional obstacles to siting a large LNG storage facility in New York City and limit the economic viability of such a project.

Although it concluded that the existing and planned facilities could be constructed and operated successfully, FERC did recommend that, as a result of its analysis, 25 specific items be included as conditions to a certificate of public convenience and necessity if the project is approved.

In early July, Judge Bramwell of the U.S. District Court for the Eastern District of New York upheld the constitutionality of the New York Liquefied Natural and Petroleum Gas Act.

ETS had in essence contended that the Natural Gas Act provisions as implemented by FERC covered, and hence preempted, the state requirements for need for the gas and attendant facilities and safety aspects as the lead federal agency under the National Environmental Policy Act. It also contended that provisions of the Natural Gas Pipeline Safety Act, as implemented by MTB, covered safety related issues of siting, design, construction, and operation. Only the land use of siting was not covered by Federal regulation and this had accounted for zoning at the time the facility was constructed.

In rejecting ETS' position of preemption, the judge concluded that the New York Act only involved siting and argued, with regard to the Gas Act, "that before a state statute can be preempted, Congress must implicitly or explicitly evidence an intent to prohibit state regulation." The court found no such intent. With regard to the NGPSA, the court concluded that the Act "does not sufficiently address the question of siting so as to preempt the New York Act." The judge, in asserting that the New York Act only involves siting and that the federal acts do not preempt state activities in this area, would appear to be on rather uncertain ground.

Subsequent to the ruling, ETS filed a petition for review in the U.S. Court of Appeals for the 2nd Circuit.

Yerevan, Armenia may be the site for construction of the

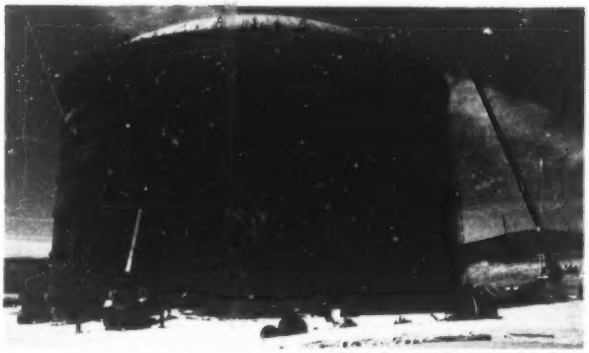


Photo Courtesy Southwest Gas Corp.

Construction is underway at Southwest Gas Corp.'s LNG peakshaving facility at Lovelock, Nev. Storage tank, shown here, will have capacity of 290,000 bbl, equivalent to 1 billion cu ft of gas. Sendout capacity will be 70 million cu ft per day. Completion is scheduled for 1982.

Soviet Union's second LNG peakshaving plant. At the Sept. 23-26, 1980, meeting of the International Institute for Applied Systems Analysis, Dr. Y. Oseradko, leading engineer, All-Union Design Institute for Gas Industry, described an LNG peakshaving facility at Yerevan in Armenia. Construction of the facility reportedly has not begun. When completed, this would be the second peakshaving facility in the Soviet Union. The first, completed outside Moscow in 1948 and built under the Lend-Lease program, is reportedly still in operation.

The facility at Yerevan is to have a liquefaction capacity of 20 tons/hr (25 million cu ft per day). Storage will be in three 60,000 m^3 (378,000 bbl) tanks. Vaporization capacity is to be 10 million m^3 (gas) per day (370 million cu ft per day). Liquefaction is designed to fill storage in 160 days, with the duration of operation being cited as 180 calendar days. Regasification capacity is designed to vaporize the stored LNG in approximately 11 days of operation. According to the description of the plant, it is designed to supply revaporized LNG to the gas pipeline from Astra on the Caspian Sea during 10 to 20 of the coldest days in winter.

Gas feed from the main gas pipeline feeding Yerevan is to be compressed in compressors from a pressure of 1.96 mPa (288 psi) to a pressure of 4.9 mPa (720 psi). After compression, CO_2 is removed and the gas dehydrated in the pretreatment step. A propane-staged mixed refrigerant cycle is to be used. The mixed refrigerant will contain nitrogen, methane, ethane, and propane. Storage will be at near atmospheric pressure. The vaporizers will be of the integral type, but it is not possible to tell from the description as to whether they are direct fired or submerged combustion. Sendout gas pressure is 5.39 mPa (790 psi).

No dates were given for completion and start-up of the peakshaving facility at Yerevan.

LNG legislation and regulation have always been areas of concern for the LNG industry. In 1980, a final rule establishing new safety standards governing operations, maintenance, fire protection, personnel qualifications and training, and security of LNG facilities was published in the Oct. 23 *Federal Register*.

The final rules as developed by the Materials Transportation Bureau had been modified from those that had been initially proposed. The modifications made were felt by many industry commentors to have made the regulations more acceptable to them.

Of a positive benefit to the industry was the signing into law on Dec. 12, 1980 of the *Methane Transportation, Research, Development, and Demonstration Act*.

The act establishes an RD&D Program with DOE to support accelerated research into the development of methane-fueled vehicles, related technologies, and domestic methane

resources. The bill authorizes $3 million for fiscal year 1982, and $5 million for each of fiscal years 1983 and 1984. Funding was to begin in October 1981.

The program is intended to demonstrate the feasibility of methane-powered vehicles for fleet use and to promote their use, espically in areas where air-quality conditions are poor. At least half of the money will be used for loans to private industry; the rest will be in the form of grants to state and local governments. The funding may not be used for actual vehicle conversion but is intended for support facilities such as methane pumps, compression and liquefaction equipment, and small-scale storage. The legislation envisages the implementation of at least 50 demonstration projects, each with at least 50 vehicles.

LNG to the rescue is a phrase that is not often heard. But it was this past winter in New England when a delivery capacity problem for pipeline gas deliveries occurred. The situation came to a head beginning Jan. 10 when three utility companies in Massachusetts declared that emergency conditions existed and asked customers to conserve gas supplies. Lowell Gas Co., Cape Cod Gas Co., and Boston Gas Co. all cited the limited availability of natural gas as the reason for the emergency.

Massachusetts Governor Edward J. King declared a state energy emergency on Jan. 13. He ordered all nonresidential buildings heated by natural gas to lower their thermostats to 55 F, but exempted such facilities as hospitals and nursing homes. Residential customers were encouraged to lower their thermostats to 63 F. Massachusetts officials also asked utilities on Sunday, Jan. 11, to pool gas resources.

City officials in Lowell declared a state of emergency and closed all schools through mid-week. They also asked businesses that could not switch to other fuels to close. Many schools were also closed on Cape Cod.

Of the three utilities, Boston Gas is the largest distributor, serving 500,000 customers in 24 cities and towns. Lowell Gas serves 37,700 residential and 3,900 commercial customers. Cape Cod services 27,400 residential and 2,900 commercial customers. Lowell Gas and Boston Gas have LNG peakshaving facilities; Boston Gas and Cape Cod Gas have satellite facilities.

The shortage of gas was caused by a delivery capacity problem. According to Boston Gas, three circumstances combined to create the crisis:

1) the coldest weather New England has had in more than 100 years,

2) delay of shipments of LNG gas from Algeria caused by a severe storm along the Mediterranean coast, and

3) a sharp "uncharacteristic" increase in gas usage by Boston Gas customers.

In addition, the three situations all developed within an extremely short period of time. One Boston Gas official indicated that if each of the three events had occurred individually, they could have been handled by the company.

Two interstate pipelines, Tennessee Gas Transmission and Texas Gas Transmission, indicated that their lines were flowing at capacity but could not flow enough gas to meet demand. LNG, the only available source of supply, was used to the maximum extent possible. However, the volumes in storage were not sufficient, and they were not designed for the level of the demand and its two-week duration. Arrival of LNG from Algeria was delayed, as noted. It should also be noted that the quantities of LNG delivered from Algeria to Distrigas of Massachusetts' terminal at Everett during the winter period of 1980-81 were at or above contract quantities. They have continued at this level to date.

To obtain a supply of LNG as rapidly as possible, Boston Gas Company contracted with Southern Energy Co. to purchase or exchange approximately 1.3 Bcf (60,000 m^3 liq.) of gas as LNG in storage at Southern Energy's terminal at Elba Island. As no American flag vessel was available to transport the LNG, a waiver of the Jones Act was necessary to transport the LNG aboard the *Larbi Ben M'Hidi*, an Algerian flag LNG carrier that was in Boston undergoing some minor shipyard repairs while awaiting the reopening of the port of Bethioua, Algeria. The *Larbi Ben M'Hidi* had delivered its cargo of LNG to DOMAC on Dec. 27-28.

On Jan. 14, the applicants – Boston Gas Co., Southern Energy Co., and Southern Natural Gas Co. – had sought a waiver and clarification of the emergency gas-sale regulations to enable Southern Energy and Boston Gas to go forward with an agreement whereby Southern Energy would provide emergency volumes of LNG to Boston Gas in exchange for thermally equivalent volumes of LNG to be redelivered by Boston Gas at a later date.

On Jan. 16, FERC commissioners issued their findings and granted the applicant's request for clarification and waiver, as required, by the Commission's Emergency Regulations. The waiver of the Jones Act provisions was obtained by Senator Kennedy's office upon the request of Governor King and the utility companies from the Treasury Department.

The *Larbi Ben M'Hidi* left Boston on Jan. 15 and arrived at Elba Island at 7 p.m. on Jan. 18. The 60,000 m^3 of LNG was loaded aboard the vessel and it departed Elba Island at 12:12 a.m. on January 20. The *Larbi Ben M'Hidi* unloaded its LNG at DOMAC's Everett terminal on Jan. 22 and 23. The unloading received very favorable extensive TV and press coverage.

Meanwhile a second Algerian LNG tanker, the *Mostefa Ben Boulaid* loaded a light cargo of LNG on Jan. 23 at Bethioua, Algeria. The 93,000 m^3 representing the heel in the storage tanks at the LNG plant arrived at DOMAC's terminal on Feb. 7.

With moderating weather, Governor King was able to lift the state executive order restricting gas usage on Jan. 25 citing diligent conservation efforts and increased supplied including LNG.

During the period from Jan. 10-25, LNG in peakshaving storage in New England, LNG delivered by tanker from Algeria, and LNG trucked from other areas including the southeastern states was a major factor in alleviating a serious supply situation.

Worldwide LNG Projects Hit By Price, Contracts

The past year of base-load LNG projects has been underscored by two factors: *price and sanctity of contract.*

The price of LNG has escalated sharply as has the price of crude oil. As a result of this escalation and a general turndown of the world's economics, a surplus of petroleum has developed. Consequently what might be termed a "firming" of energy prices has occurred. Because many LNG base-load supply contracts are tied to alternative fuels or to the price of a market basket of crudes, LNG prices have moved upward in tandem with other energy prices.

The problem from the exporting country's view has been and continues to center about the issues of the base price value from which the escalation is calculated, whether the change in price of his crude oil is fully reflected in the LNG price, and whether his price reflects an f.o.b. price or a c.i.f. price for the product.

It is this latter question of who pays for the higher cost of transport and terminalling LNG that has led to the problems relating to sanctity of contract. The importing country views natural gas as being a product that does not and cannot compete directly with imported oil. In a period of shrinking economic activity he cannot afford to price his product out of reach of his customers.

The impact of LNG prices over the past 18 months is

exemplified by Japan. In 1980 Japan accounted for approximately 73.8% of the world trade in LNG. The percentage represented by the Japanese trade was indeed up sharply over 1979 when Japan accounted for only 56% of the world's LNG trade. Japan's trade volume, however, did increase between 1979 and 1980.

Regarding price, Japan paid an average price in 1980 for her imported LNG that was 79.5% higher than the price paid to her suppliers in 1979. During the first half of 1981, the average price paid only escalated by 13.1%. On a Btu basis the prices paid in June for LNG from the four suppliers were Indonesia – $5.16/MMBtu, Brunei – $6.38/MMBtu, Abu Dhabi – $6.60/MMBtu, and Alaska – $6.22/MMBtu.

Indonesia was the lowest priced source of supply, reflecting in part the influence of the U.S. dollar's strength compared to a market basket of currencies on the pricing formula. Abu Dhabi was the highest priced supply reflecting the fact that its supply contract ties the price of LNG directly to the price of its Murban 39° crude oil.

On the other side of the world, Algeria successfully renegotiated its LNG sales price with one customer, Distrigaz S.A. of Belgium. On April 8 the announcement was made of a new pricing provision covering deliveries over a 20-year period beginning in October 1982. The provisions announced by Algeria's Oil Minister Belkacem Nabi included an f.o.b. base price of $4.80/MMBtu effective on Jan. 1, 1981. This price will escalate 100% with the price of a basket of crude oils based 50% on those imported by Belgium and 50% on those from OPEC countries exporting LNG. As of Jan. 1, 1981, a year later, the calculated price had escalated by 17%, to an estimated $5.60 MMBtu.

In announcing the agreement, Minister Nabi described it as a starting point and basis for future gas sales contracts with Algerian customers and the first contract to establish a formula that ties the price of gas exports to those of crude oil. As of the date of this writing, Algeria has yet to conclude a revised pricing provision for any of its sales contracts. Negotiations are proceeding with varying intensities with each of them.

Concern over sanctity of contract was brought to a head when the last cargos of Algerian LNG arrived at U.S. terminals under the El Paso project. The dates were April 10, 1980, for the Cove Point, Md., terminal and April 9, 1980, for the Elba Island terminal.

The cessation of deliveries resulted from the rejection of amended contract terms by the Algerian government. Algeria considered that the contract with the El Paso Co. was, therefore, no longer in force. El Paso considered that the *Force Majeure* provisions of the contract had been invoked.

Negotiations were begun to arrive at a new provision that could be acceptable to both parties (El Paso Co. and Sonatrach) and both countries (Algeria and the United States). Because approval for any amended contract terms would need to be approved by the U.S. government, the negotiations were carried out on a state-to-state basis. Leslie Goldman, assistant secretary of energy for international affairs, headed the U.S. team.

Negotiations continued with the location shifting back and forth between Algeria and Washington. Progress was reported to be substantial or minimal with each meeting but no agreements were concluded. With President Carter losing the election, time for conclusion of an agreement under his term of office grew short. The sixth and last negotiation under his administration took place in Washington Jan. 12-16.

The f.o.b. price was one of the areas of remaining disagreement. The U.S. negotiators were reportedly still seeking parity with the Canadian price of $4.94/MMBtu, less a transportation and handling charge of approximately $1.25/MMBtu, for an f.o.b. price of about $3.70/MMBtu. The Algerians are believed to have been seeking a price of about $4.00/MMBtu f.o.b. Escalation based on an energy equivalence with crude oil escalation as the Algerians were seeking or on other U.S. gas imports as DOE was seeking also remained an unresolved issue.

With the change of administrations, the Algerians had apparently perceived that negotiations would not resume until after the Reagan administration appointed replacements for the negotiators, and they had been brought up-to-date on the previous discussions and outstanding issues. To forestall delay in the negotiating procedure, Travis Petty, chairman, president, and CEO of the El Paso Co., went to Algeria and discussed the incomplete negotiations with Minister Belkacem Nabi the following week. As a result of these discussions and communications with the new Administration, the next meeting was scheduled for Feb. 17 in Algeria.

The financial press reported that El Paso was delaying determination of its 1980 fourth-quarter and full-year earnings because of the meeting. But if the meeting fails to produce an "acceptable agreement," El Paso indicated it would have to determine the "appropriate valuation" of its LNG investment as of Dec. 31, 1980, "in light of the diminished prospects for project resumption."

After two days, the seventh and final government-to-government negotiations to resolve the price impass that had suspended deliveries under the El Paso project ended in failure on Feb. 18. No further negotiations were planned. As a result, the El Paso Co. announced that it would write down its investments and would eventually dissolve its El Paso LNG, El Paso Marine, and El Paso Algeria companies.

At the conclusion of the unsuccessful negotiations, an embassy spokesman commented that the two sides made a serious effort to reach settlement but "were unable to agree upon the complex energy policy issues involved in considering a governmental framework for this commercial transaction. No further inter-governmental meetings are planned."

El Paso's assets from the project included six operational and three non-operational LNG carriers and facilities related to the receiving terminals here and the export facility in Algeria.

All of the LNG carriers were placed on the market. The six operational carriers, which were either in layup in Greece or at shipyards in France undergoing repairs and modifications, were brought back to the U.S. for layup in Narrangansett Bay. The three non-operational vessels were already in layup at Boston.

The parent companies of El Paso's customers (Columbia LNG Corp., Consolidated System LNG Co., and Southern Energy Co.) decided to negotiate directly with Algeria's Sonatrach after El Paso's decision to write off its LNG investment. They had decided not to write off their investments. In mid-April the three firms engaged the services of Warren M. Christopher who, as deputy secretary of state under President Carter, headed the successful U.S. negotiation team for the release of the hostages in Iran. After leaving Washington with the change in administration, Christopher had returned as a partner to the law firm of O'Melvany and Meyers in Los Angeles.

The first meeting on this company-to-company basis was held in Algiers on May 23 and 24. The atmosphere of this and subsequent negotiating sessions to date have been characterized as friendly and productive. To date, no agreement on a contract has been reached.

It is not really possible to categorically blame one side or another for the termination of a base-load LNG project for reasons other than the expiration of contract term. Perhaps the blame should rest with the United States government negotiators for a position on a net back price calculation that placed emphasis on an unreasonably low starting point. Perhaps it should lie with the Algerians who may have failed to realize the urgency for reaching agreement and need for compromise. The deed is done. Perhaps the industry will learn from it.

P&GJ

SCORECARD — U.S. and Canadian LNG Peakshaving Facilities — November 1981

Company and Plant Site	Liquefaction Plant Capacity MMcfd day	Storage Capacity MMcf	Storage Capacity MBbl	Total Design Capacity	Regasification — MMcfd Runs	Regasification — MMcfd No. of Days	Regasification — MMcfd Type	Type of Storage Container	Storage Contractor	Liquefaction Plant Contractor	Type of Cycle	Year of Operation
APCI-NEGEA Hopkinton Mass	16 5	2000 (2 at 290)	580	248	4 at 62	8	Submrgd	Aboveground 9% nickel	CBI	Cryo Methane	Cascade	1967 — plant 1971 on new tanks
APCI-NEGEA Hopkinton Mass	—	1000	290	—	—	—	—	Aboveground 9% nickel	CBI	—	—	1975 — third tank
ALABAMA GAS CORP Birmingham Ala	4 65	625	180	127 65	3 at 42 5	10	Submrgd	Aboveground aluminum	CBI	Air Products & Chemicals Inc	Cascade	1965
ALABAMA GAS CORP Birmingham Ala	—	625	180	42 5	1 at 42 5	—	Submrgd	Aboveground aluminum	CBI	—	—	1971 — second tank
ALABAMA GAS CORP Coosada Ala	2 7	600	175	80	2 at 40	15	Submrgd	Aboveground aluminum	CBI	CBI	Modified Cascade	1972
ATLANTA GAS LIGHT CO Riverdale Ga	10 0	1000	290	200	3 at 100	5	Uniflux	Aboveground aluminum	CBI	Air Liquide	TEAL Expander Process boost	1972
ATLANTA GAS LIGHT CO Riverdale Ga	—	1500	450	—	—	—	—	Aboveground 9% nickel	CBI	—	—	1973
ARKANSAS-MISSOURI POWER CO Yarbro Ark	0 86	374	110 (2 x 55)	66	2 at 33	6	Direct Fired	Aboveground aluminum	Brown Minneapolis Tank & Fab Co	Process Constructors Inc	Stirling	1973 — (1972 as satellite)
BALTIMORE GAS & ELEC CO Baltimore Md	2 75	500	145 (2 x 72 5)	167 5 125	3 at 62 5	5	Submrgd	Aboveground aluminum	CBI	CBI	Expander	1971
BALTIMORE GAS & ELEC CO PLANT No 2 Baltimore Md	2 4	500	145	62 5	1 at 62 5	8	Submrgd	Aboveground aluminum	CBI	CBI	MRL	1973
BAY STATE GAS CO Ludlow Mass	7 5	1000	290	55	1 at 25 2 at 15	35	Uniflux	Aboveground 9% nickel	CBI	J F Pritchard	PRICO	1973
BOSTON GAS CO Boston Mass	6 0	1000	290	187 5 125	3 at 62 5	5	Submrgd	Aboveground 9% nickel	CBI	CBI	Expander	1968
BOSTON GAS CO Boston Mass	—	1120	331	—	—	—	—	Aboveground aluminum	CBI	—	—	1971 — second tank
BOSTON GAS CO Lynn Mass	7 85	1000	290	86 4 57 6	3 at 28 8	12	Submrgd	Aboveground 9% nickel	PDM	Air Products & Chemicals Inc	MCR	1972
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY Vancouver B C	2 5	625	180	150 100	3 at 50	6	Submrgd	Aboveground 9% nickel	Pittsburgh Des Moines Steel	Air Liquide	TEALARC	1971
BROOKLYN UNION GAS CO Brooklyn N Y	3 68	625	175	100	2 at 50	4	Direct Fired	Aboveground 9% nickel	CBI	American Meter	Expander	1968
BROOKLYN UNION GAS CO Brooklyn N Y	—	1000	290	50	2 at 25	—	Direct Fired	Aboveground 9% nickel	CBI	—	—	1971 — second tank
				125	2 at 62 5	—	Submrgd					1979
				175	2 at 62 5	—	Submrgd					1979
CHATTANOOGA GAS CO Chattanooga Tenn	10 0	1200	348	90 60	3 at 30	70	Direct Fired	Aboveground 9% nickel	PDM	J F Pritchard	PRICO	1973
CITIZENS GAS & COKE UTILITY Beech Grove Ind	5 0	1000	290	180	3 at 60	5	Submrgd	Aboveground aluminum	PDM	Air Liquide	TEALARC	1972
COMMONWEALTH NATURAL GAS CO Tidewater Va	5 0	1290	348	105	3 at 35	12	Direct Fired	Aboveground 9% nickel	PDM	Envirogenics	Cascade	1970
CONNECTICUT NATURAL GAS CORP Rocky Hill Con	6 6	1200	348	80 55	2 at 25 1 at 30	24	Vapor Trim Submrgd	Aboveground 9% nickel	PDM	Arrio Chrysanis	Expander Nitrogen	1972
CONSOLIDATED EDISON CO Astoria N Y	6 0	1000	290	300 240	5 at 60	4	N A	Aboveground 9% nickel	PDM	Arrio Chrysanis	Expander Nitrogen	1974
DELMARVA POWER & LT CO Wilmington Del	1 71	250	72 5	50	2 at 25	5	Direct Fired	Aboveground aluminum	CBI	Linde AG	Expander Nitrogen	1972
EAST TENNESSEE NATURAL GAS CO Fordtown Tenn	5 5	1200	348	150	2 at 75	8	Direct Fired	Aboveground aluminum	CBI	CBI	MRL	1975
ENERGY TERMINAL SERVICES CORP Staten Island N Y (Conversion of part of terminal capacity to peakshaving Uses two storage tanks and an LP vaporization capacity)	30 0	6000	1800	360	2 at 60 2 at 120	9	Direct Fired	Prestressed concrete	Preload Atlech	NA	NA	1982 planned
FALL RIVER GAS CO Fall River Mass	0 5	150	45	10	1	15	Direct Fired	Aboveground 9% nickel	PDM	DH Lotz	Dual u T Cycle	1970
GAS LIGHT CO OF COLUMBUS Columbus Ga	1 7	500	145	60	2 at 40	8	Indirect Fluid	Aboveground aluminum	CBI	CBI	Expander	1974
GAZ METROPOLITAIN INC Montreal Que Canada	10 0	1000	290	180	3 at 60	16	Submrgd	Aboveground 9% nickel	Horton (CBI)	Air Liquide	TEALARC	1969
GAZ METROPOLITAIN INC Montreal Que Canada	—	1000	290					Aboveground 9% nickel	Horton (CBI)			1970 — second tank
INTERMOUNTAIN GAS CO Boise Idaho	4 0	500	175	90 60	3 at 30	13	Submrgd	Aboveground aluminum	PDM	Linde AG	Expander Nitrogen	1974
IOWA-ILLINOIS GAS & ELEC CO Bettendorf Iowa	2 0	500	145	50	2 at 25	10	Uniflux	Aboveground aluminum	CBI	CBI	MRL	1972
IOWA POWER & LT CO Des Moines Iowa	2 0	400	116	30	2 at 15	13	Intermed Fluid	Aboveground aluminum	CBI	CBI	MRL	1975
IOWA PUBLIC SERVICE CO Waterloo Iowa	2 5	400	117	40	2 at 15	26	Intermed Fluid	Aboveground aluminum	PDM	APCI (prime) Air Liquide (liquefaction)	TEALARC	1976
IOWA PUBLIC SERVICE CO Waterloo Iowa		400	117					Aboveground aluminum	CBI			1978 — second tank
KOKOMO GAS & FUEL CO Kokomo Ind	1 3	400	116	30 15	2 at 15	25	Intermed Fluid	Aboveground aluminum	CBI	CBI	Expander	1973
KOKOMO GAS & FUEL CO Kokomo Ind	1 25	—	—	—	—	—	—	(Second liquefaction unit)	—	CBI	MRL	1974
LONG ISLAND LIGHTING CO Holbrook N Y	3 0	600	175	200 150	4 at 50	4	Submrgd	Aboveground 9% nickel	PDM	Linde AG	Cascade Mixed Refrigerant	1971
LOWELL GAS CO Lowell Mass	4 5	1000	290	70 70	2 at 30 1 at 10	16	Direct Fired	Aboveground 9% nickel	Graver Envirogenics	Envirogenics	Expander	1969
MEMPHIS LIGHT GAS & WATER DIV Memphis Tenn	5 0	1000	290	201	3 at 67	5	Submrgd	Aboveground 9% nickel	CBI	Air Liquide	Cascade	1967
METRO UTILITIES DISTRICT Omaha Nebr	6 0	1000	290	60 30	2 at 30	33	Submrgd	Aboveground 9% nickel	CBI	Linde AG	Expander Nitrogen	1975
MINNESOTA GAS CO Burnsville Minn	5 0	1000	290	60	2 at 40	12	Intermed Fluid	Aboveground 9% nickel	CBI	CBI	MRL	1976
NORTHERN IND PUBLIC SERVICE CO La Porte Ind	10 0	2000	580	300 200	3 at 100	10	Direct Fired	Aboveground 9% nickel	CBI	J F Pritchard	PRICO	1974
NORTHERN IND PUBLIC SERVICE CO La Porte Ind	10 0	2000	580	340 290	3 at 100	10	Submrgd	Aboveground	CBI	Linde	Mixed Refrigerant	1981
NORTHERN & CENTRAL GAS CO Hagar Ontario	2 5	625	180	65	3 at 42 5	7	Submrgd	Aboveground 9% nickel	Horton (CBI)	Air Liquide	TEALARC	1968
NORTHERN & CENTRAL GAS CO Hagar Ontario	—	—	—	—	1 at 42 5	—	Submrgd	Aboveground 9% nickel	Horton (CBI)	Linde Eng		1977
NORTHERN NATURAL GAS CO Wrenshall Minn	10 0	2165	630	200	2 at 100	10	Submrgd	Aboveground 9% nickel	PDM	SD Plants	TEALARC	1975
NORTHERN NATURAL GAS CO Ventura Iowa	14 5	2165	630	300	3 at 100	7	Submrgd	Aboveground 9% nickel	PDM	MW	PRICO	1978
NORTHERN STATES POWER CO Eau Claire Wisc	2 0	270	78	24 24	2 at 12 3 at 38	11	Direct Fired	Aboveground aluminum	CBI	CBI	Expander	1969
NORTHERN STATES POWER CO Wescott Minn	10 0	2130	580 (2 x 290) (1 x 32)	136	2 at 24	28	Direct Fired	Aboveground 9% nickel	CBI	CBI	MRL	1972 1975
NORTHWEST NATURAL GAS CO Portland Ore	2 5	625	175	200	2 at 60 1 at 20 2 at 30	10	Direct Fired Submrgd	Aboveground aluminum	CBI	CBI	Expander	1969
NORTHWEST NATURAL GAS CO Newport Ore	5 0	1200	348	100 100	2 at 50	12	Submrgd	Aboveground 9% nickel	CBI	CBI	MRL CRYEN	1977
NORTHWEST PIPELINE CORP Plymouth Wash	6 0	1200	348	225	3 at 75	8	Submrgd	Aboveground aluminum	PDM	Air Liquide	TEALARC	1975
NORTHWEST PIPELINE CORP Plymouth Wash	6 0	1200	348	75	1 at 75	15	Submrgd	Aboveground 9% nickel	PDM	Air Liquide	TEALARC	1978
PEOPLES GAS LIGHT & COKE Fisher Ill	10 0	2900	580 (2 x 290)	300 200	3 at 67 1 at 100	10	Direct Fired	Aboveground aluminum	CBI	CBI	Expander	1972
PHILADELPHIA ELECTRIC CO West Conshohocken Pa	6 6	1200	348	310 186	5 at 62	4	Submrgd	Aboveground 9% nickel	CBI	Arrio Chrysanis	Expander Nitrogen	1972
PHILADELPHIA GAS WORKS Philadelphia Pa	25 0	4000	1166 (2 x 583)	500 400	5 at 100	16	Intermed Fluid	Aboveground Prestressed concrete	Preload	J F Pritchard	Cascade	1969 — Plant operable 1974 on tanks
PIEDMONT NATURAL GAS CO Charlotte N Car	5 0	1000	290	150	3 at 50	7	Direct Fired	Aboveground 9% nickel	CBI	CBI	MRL	1973

Cont'd U.S. and Canadian LNG Peakshaving Facilities

Company and Plant Site	Liquefaction Plant Capacity MMcfd day	Storage Capacity MMcf	Storage Capacity MBbl	Total Design Capacity	Regasification - MMcfd Runs	No. of Days	Type	Type of Storage Container	Storage Contractor	Liquefaction Plant Contractor	Type of Cycle	Year of Operation
PUBLIC SERVICE CO. OF NORTH CAROLINA, Gastonia, N. C.												
ROANOKE GAS CO. Roanoke, Va.												
SAN DIEGO GAS & ELECTRIC CO. Otay Mesa Gas Turb. No. 1 Plant												
SAN DIEGO GAS & ELECTRIC CO. Otay Mesa Gas Turb. No. 2 Plant												
SOUTH CAROLINA NG CO. Burney Park, So. Car.												
SOUTHERN CONNECTICUT GAS CO. Milford, Conn.												
SOUTHWEST GAS CORP. Clarkdale, Ariz.												
TENNESSEE NATURAL GAS LINES, INC. Nashville, Tenn.												
TEXAS EASTERN TRANS. CO. Staten Island, N.Y.												
TRANSCONTINENTAL GAS P.L. CORP. Hackensack, N.J.												
TRANSCONTINENTAL GAS P.L. CORP. Hackensack, N.J.												
UGI CORP. Temple, Pa.												
UTILITIES BOARD Treasure Isle												
WISCONSIN NATURAL GAS CO. Oak Creek, Wisc.												

International LNG Peakshaving Facilities

Company and Plant Site	Liquefaction Plant Capacity MMcfd day	Storage Capacity MMcf	Storage Capacity MBbl	Total Design Capacity	Regasification - MMcfd Runs	No. of Days	Type	Type of Storage Container	Storage Contractor	Liquefaction Plant Contractor	Type of Cycle	Year of Operation
BRITISH GAS CORP. Aspinwall, Aust.												
BRITISH GAS CORP. Aspinwall, Aust.												
BRITISH GAS CORP. Germiston, Scotland												
BRITISH GAS CORP. Germiston, Scotland Old plant												
BRITISH GAS CORP. Partington, Cheshire, England												
BRITISH GAS CORP. Partington, Cheshire, England Old plant												
BRITISH GAS CORP. Isle of Grain, Kent												
BRITISH GAS CORP. Isle of Grain, Kent												
BRITISH GAS CORP. Bonnyr Arm, S. Alex.												
BRITISH GAS CORP. Canvey Island, England												
N.V. NEDERLANDSE GASUNIE Maasvlakte, The Netherlands												
DISTRIGAZ S.A. Zeebrugge, Belgium												
STUTTGART CITY UTILITIES Stuttgart, W. Germany												
THYSSEN GAS GMBH Duisburg, Hamborn (A. Germany												
GAS & FUEL CORP. OF VICTORIA Dandenong, Victoria, Australia												

EUROPEAN SATELLITE PEAKSHAVING FACILITIES

Company	Plant Location	LNG Source	Storage Volume MMcf	Storage Volume MBbl	Sendout Capacity MMcf day	Type of Storage Container	Storage Contractor	Systems Contractor	Year of Operation
British Gas Corp.	Ambergate, Derbyshire, England	Importer LNG from Canvey Island	260	70	64	Field erected aluminum	Whessoe Ltd.	Whessoe Ltd. Hepworth Engineering Refrigeration	1968
British Gas Corp.	Avonmouth, Avonmouth, Bristol, U.K.	British Gas Corp. Canvey Island, England	2,084	2,000	0.360	Shop fabricated 9% nickel	Air Products Ltd.	British Gas Corp. Wales Region	1973
British Gas Corp.	Glenmavis, Bathgate, Scotland, U.K.	British Gas Corp. Canvey Island, England	1,510	1,450	1.200	Shop fabricated aluminum dome	Cryogenic Ltd.	British Gas Corp. Scottish Region	1972
British Gas Corp.	Dalkeith, Edinburgh, Scotland, U.K.	British Gas Corp. Canvey Island, England	1,514	1,450	0.480	Shop fabricated 9% nickel inner tank, aluminum outer tank, perlite insulation	Low Temperature Engineering Ltd. Air Products Ltd.	British Gas Corp. Scottish Region	1972
British Gas Corp.	Tonedale, Wellington, Somerset, U.K.	British Gas Corp. Canvey Island, England	1,540	1,480	1.100	Shop fabricated 9% nickel	Air Products Ltd.	Br. Gas Corp. Southern Region	1973
British Gas Corp.	Partington, Altrincham, Cheshire, U.K.	British Gas Corp. Canvey Island, England	4,280	4,100	1.440	Shop fabricated 9% nickel	Air Products Ltd.	British Gas Corp. Northern Region	1973
British Gas Corp.	Glenmavis, Bathgate, Scotland, U.K.	British Gas Corp. Canvey Island, England	1,348	1,300	0.360	Shop fabricated aluminum dome	Cryogenic Ltd.	British Gas Corp. Scottish Region	1973
British Gas Corp.	Dalkeith, Edinburgh, Scotland, U.K.	British Gas Corp. Canvey Island, England	1,540	1,480	0.480	Shop fabricated 9% nickel inner tank, aluminum outer tank, perlite insulation	Air Products Ltd.	British Gas Corp. Scottish Region	1973
British Gas Corp.	Methil, Dunfermline, Scotland, U.K.	British Gas Corp. Canvey Island, England	1,350	1,300	0.350	Shop fabricated aluminum dome	Cryogenic Ltd.	British Gas Corp. Scottish Region	1973

Cont'd EUROPEAN SATELLITE PEAKSHAVING FACILITIES

Company	Plant Location	LNG Source	Storage Volume MMcf	Storage Volume MBbl	Sendout Capacity MMcf/day	Type of Storage Container	Storage Contractor	Systems Contractor	Year of Operation
Gaz de France	Nantes, Loire-Atlantique, France	Gaz de France Lehavre, France	58.3	15.5	17.0	Field erected 1 tank @ 1% nickel 3145 bbl; 1 tank concrete roof 12,579 bbl	Chicago Bridge & Iron Gas Transport	Gaz de France	1966
Gaz de France	Dreux, Melun, France	Gaz de France Le Havre, France	11.7	3.11	35.3	Field erected 9% nickel	Bigler Smith Laurent	Gaz de France	1976
Erdgas Südbayern GmbH	Lenbach, W. Germany	Technische Werke der Stadt Stuttgart W. Germany	11.5	3.829	11.2	Shop fabricated	Linde AG	Linde AG	1974
Technische Werke der Stadt Stuttgart	Stuttgart	Technische Werke der Stadt Stuttgart W. Germany	1.985	0.258	1.429	Truck transport	Linde AG and Aunays	Technische Werke der Stadt Stuttgart	1976
Thyssengas GmbH	Duisburg	Thyssengas Duisburg-Hochfeld W. Germany	0.935	0.249	0.349	Truck transport	Aunays	Thyssengas	1977
Gas Figueres S.A.	Figueres, Spain	Distrigas Barcelona, Spain	3.280	1.24	3.08	Shop fabricated stainless steel	Metalmecanica y Pena	Enagas	1971
Gas Costa Brava S.A.	Gerona, Spain	Distrigas Barcelona, Spain	2.870	0.995	3.08	Shop fabricated stainless steel	Magyar(s) Teixeiro Marina	British Oxygen	1977
Gas Tarragona S.A.	Tarragona, Spain	Distrigas Barcelona, Spain	1.955	0.679	2.141	Shop fabricated stainless steel	Air Liquide Spain		1977
Sagrates Gas Calpe S.A.	Alicante, Spain	Distrigas Barcelona, Spain	3.280	1.070	3.146	Shop fabricated stainless steel	Air Liquide Spain		1978
Catalana Gas S.A.	Sitges, Spain	Distrigas Barcelona, Spain	2.764	1.064	3.080	Shop fabricated stainless steel	Magyar(s) Teixeiro Marina	British Oxygen	1977
Gas Tarsa S.A.	Sagunto, Spain	Distrigas Barcelona, Spain	2.870	0.978	N.A.	Shop fabricated stainless steel	N.A.	N.A.	1977
Tarmac Cohenoil	Tarmac, Spain	Distrigas Barcelona, Spain	0.438	0.126	0.308	Shop fabricated stainless steel	Air Liquide Espana	Air Liquide Espana	1978

NA — Not Available

LNG Satellite Peakshaving Facilities Small Capacity Plants — Shop Builtup Components

Company	Plant Location	LNG Source	Storage Volume MMcf	Storage Volume M gal	Sendout Capacity MMcf/day	Type of Storage Container	Storage Contractor	Systems Contractor	Year of Operation
Bay State Gas Co.	Weymouth, Mass.	Bay State Storage	4.0	1.08	10.0	Shop built up cylinders	Process Eng.	Gas Tech.	1971
City of Brownsville Gas Dept.	Brownsville, Tenn.	Memphis, LNG	1.1	0.3	10.0	Spiral shuttle	Ryan Industries	City of Brownsville Gas Dept.	1970
Cape Cod Gas Co.	South Yarmouth, Mass.	Lower Cape Cod	3.1	0.83	3.8	Shop built up cylinder	Process Eng.	Process Eng.	1970
Cape Cod Gas Co.	Wellfleet, Mass.	Lower Cape Cod	4.0	1.08	2.16	Shop built up cylinders	Process Eng.	Gas Tech.	1974, 1978
Concord Natural Gas Corp.	Concord, N.H.	Boy State Storage	3.1	0.8	3.8	Shop built up cylinders	Process Eng.	Gas Tech.	1974
Consumers Gas Co.	Weymouth, Mass.	Bay State Storage	4.1	1.08	3.8	Shop built up cylinders	Process Eng.	Gas Tech.	1975
Dekalb Chesapeake Utilities Gas District	Fort Pierce, Fla.	Chattanooga, Tenn.	1.1	0.3	2.0	Shop built up cylinders	Cast Equip.	Cast Eng. Assoc.	1972
Elizabethtown Gas Co.	Elizabethtown, Pa.	Lancaster, Pa.	1.1	0.3	0.8	Shop built up cylinders	Process Eng.	H.M.	1971
Fitchburg Gas & Electric Light	Fitchburg, Mass.	Lower Cape Cod	2.1	0.6	5.0	Shop built up cylinders	Process Eng.	Gas Tech.	1974
Gas Service Inc.	Nashua, N.H.	New England LNG	2.1	0.6	7.0	Shop built up cylinders	Process Eng.	Gas Tech.	1975
Hingham Gas Department	Hingham, Mass.	Lower Cape Cod	4.0	1.08	12.0	Shop built up cylinders	Process Eng.	Gas Tech.	1971
Lawrence Gas Co.	Lawrence, Mass.	Lower Cape Cod	10.1	2.70	18.0	Shop built up cylinders	H.C. Johnson	Gas Tech. and Northeast Gas Assoc.	1969, 1972
Lowell Gas Co.	Wilmington, Mass.	Lower Cape Cod	7.1	1.9	17.0	Shop built up cylinders	H.C. Johnson	Gas Tech.	1971
Lowell Gas Co.	Dracut, Mass.	Lower Cape Cod	4.0	1.08	4.0	Shop built up cylinders	Process Eng.	Gas Tech.	1972, 1974
Manchester Gas Co.	Manchester, N.H.	New England LNG	3.1	0.8	6.0	Shop built up cylinders	Process Eng.	Process Eng.	1975
Middleton Gas & Electric Dept.	Middleton, Mass.	Lower Cape Cod	2.5	0.7	5.0	Shop built up cylinder	Process Eng.	Gas Tech.	1970
Hartford Elec. Lt. Co.	Glastonbury, Conn.	Distrigas & New England LNG	4.0	1.0	7.0	Shop built up cylinders	Ryan Industries	N.E. Utilities	1972
Hartford Elec. Lt. Co.	Rocky Hill, Conn.	Distrigas & New England LNG	4.0	1.0	3.8	Shop built up cylinders	Ryan Industries	N.E. Utilities	1972
Hartford Elec. Lt. Co.	Tolland, Conn.	Distrigas & New England LNG	4.0	1.0	3.8	Shop built up cylinders	Ryan Industries	N.E. Utilities	1972
Connecticut Lt. & Power Co.	Meriden, Conn.	Distrigas & New England LNG	4.1	1.0	7.2	Shop built up cylinders	Process Eng.	Gas Tech.	1972
Connecticut Lt. & Power Co.	Waterbury, Conn.	Distrigas & New England LNG	12.4	3.0	7.2	Shop built up cylinders	Ryan Industries	N.E. Utilities	1972
Connecticut Lt. & Power Co.	Newington, Conn.	Distrigas & New England LNG	4.1	1.0	7.4	Shop built up cylinders	Ryan Industries	Gas L&F	1975
Northern Utilities Co.	Lewiston, Me.	New England LNG	12.4	3.0	7.2	Shop built up cylinders	Process Eng.	Applied Engineering Gas Tech.	1971, 1975, 1977
City of Norwich (Conn.) Dept. of Public Utilities	Norwich, Conn.	New England LNG	4.1	1.0	7.2	Shop built up cylinders	Process Eng.	Gas Tech.	1972
Piedmont Natural Gas Company	Lexington, N.C.	American LNG Corp.	4.1	1.0	7.2	Shop built up cylinders	Process Eng.	Process Eng.	1971
Savannah Public Utility Dept.	Savannah, Tenn.	Chattanooga Gas Co.	3.85	1.0	11.5	Spiral shuttle	Process Eng.	Process Eng.	1973
United Cities Gas Co.	Murfreesboro, Tenn.	Chattanooga Gas Co.	4.5	1.0	8.2	Shop built up cylinders	Process Eng.	Process Eng.	1973
UGI Corporation	Hazleton, Pa. (plant site)	Gibbstown, N.J. Temple, Pa.	3.85	1.0	7.0	Spiral shuttle	Process Eng.	Cosmodyne	1974
Westfield Gas Dept.	Westfield, Mass.	Lower Cape Cod	4.0	1.08	12.0	Shop built up cylinders	Process Eng.	Gas Tech.	1971, 1974
Wisconsin Gas Co.	Blue Lake, Wis.	Northern Illinois Power	14.0	3.78	7.2	Shop built up cylinders	Process Eng.	Gas Tech.	1974
Middle Tennessee Natural Gas Authority	Smithville, Tenn.	Memphis LNG Co.	1.1	0.3	8.08	Spiral shuttle	American LNG Co.	American LNG Co.	1975

LNG Satellite Facilities in Japan

Company	Plant Location	LNG Source	Storage Volume MMcf	Storage Volume MBbl	Sendout Capacity MMcf/day	Type of Storage Container	Storage Contractor	Systems Contractor	Year of Operation
Tokyo Gas Co	Hitachi, Ibaraki	Tokyo Gas Co Negishi, Sodegaura	31.6	6.20 1 x 6.57 + 0.36	105.2 x 22 + 69	Field erected	Nippon Oxygen	Tokyo Gas Company	1970
Washinomiya Gas Co	Washinomiya, Saitama	Tokyo Gas Co Negishi, Sodegaura	3.77	0.736 (3 x 0.113)	33.3 x 11	Shop fabricated	Tokyo Oxygen	Tokyo Gas Company	1971
Sobe Gas Co	Higashidatsuoka, Saitama	Tokyo Gas Co Negishi, Sodegaura	3.43	0.106 (3 x 0.043)	10.2 x 5	Shop fabricated	Nippon Oxygen	Tokyo Gas Company	1975
Mito Gas Co	Mito, Ibaraki	Tokyo Gas Co Negishi, Sodegaura	7.29	1.479 (3 x 0.726)	66.3 x 22	Shop fabricated	Nippon Oxygen	Tokyo Gas Company	1977
Tokyo Gas Co	Kohoku Complex	Tokyo Gas Co Negishi	17.9	3.648	N.A.	Shop fabricated	Tokkai Oxygen, Nippon Sanso	Tokyo Gas Company	1981

LNG Satellite Peakshaving Facilities Large Capacity Plants — Field Constructed K.D. Components

Company	Plant Location	LNG Source	Storage Volume MMcf	Storage Volume MBbl	Sendout Capacity MMcf/day	Type of Storage Container	Storage Contractor	Systems Contractor	Year of Operation
Atlanta Gas Light Co	Macon, Ga	Southern Energy	1500	250.0	180.0	Aboveground	Pitt	Pullman Kellogg	1972
Austin Gas Dept	Austin, Ga	American LNG Corp	90	15.0	9.0	Aboveground	Pitt	Pitt	1972
Bay State Gas Co	Easton, Mass	Distrigas	450	75.0	45.0	Aboveground	Pitt	Pitt	1972
Boston Gas Co	Salem, Mass	Boston Gas	1400	240.0	140.0	Aboveground	Pitt	Pitt	1972
Cape Cod Gas Co	South Yarmouth, Mass	Cape Cod Gas	175	31.5	17.5	Aboveground	Pitt	Pitt	1971
Chicago Bridge & Iron Co	Plainfield, Ark	American LNG Corp	90	15.0	9.0	Aboveground	Pitt	Pitt	1973
Elizabethtown Gas Co	Elizabeth, N.J.	Distrigas	1500	250.0	150.0	Aboveground	Pitt	Pitt	1972
Fort Hill Natural Gas Authority	Fort Hill, S.C.	American LNG Corp	90	15.0	9.0	Aboveground	Pitt	Pitt	1973
Haverhill Gas Co	Haverhill, Mass	Distrigas	600	100.0	60.0	Aboveground	Pitt	Pitt	1972
Lynchburg Gas Co	Lynchburg, Va	Hopewell Gas Co	90	15.0	9.0	Aboveground	Chicago Bridge & Iron	Pullman Kellogg	1973
New Bedford Gas & Edison Light Co	Acushnet, Mass	Hopewell, Va	600	100.0	60.0	Aboveground	Pitt	Pullman Kellogg	1971
New Bedford Gas & Edison Light Co	Acushnet, Mass	Hopewell, Va	600	100.0	60.0	Aboveground	Pitt		1971 1982 Mod
New Jersey Natural Gas Co	Ocean Township, N.J.	Distrigas	1500	250.0	150.0	Aboveground	Pitt	Pitt	1971
New Jersey Natural Gas Co	Howell Township, N.J.	Distrigas	450	75.0	45.0	Aboveground	Pitt	Pitt	1973
Northern States Power Co	LaCrosse, Wis	N/A	600	100.0	60.0	Aboveground	Pitt	Pitt	1969
Philadelphia Gas Works	Philadelphia, Pa	Algeria	1500	250.0	150.0	Aboveground	Pitt	Pullman Kellogg	1971
Providence Gas Co	Exeter, R.I.	Distrigas	1500	250.0	150.0	Aboveground	Chicago Bridge & Iron	Pullman Kellogg	1972
Public Service Gas & Electric Co	Burlington Township, N.J.	Distrigas	1500	250.0	150.0	Aboveground	Pitt	Pullman Kellogg	1969
Springfield Gas Utility	Springfield, Tenn	Algeria	450	75.0	45.0	Aboveground	ACF	ACF	1973
South Jersey Gas Co	Mickle City, N.J.	Distrigas	600	100.0	60.0	Aboveground	Pitt	Pitt	1972
Valley Gas Co	Cumberland, R.I.	New England LNG Co	90	15.0	12.0	Aboveground	Pitt	Pullman Kellogg	1971

U.S. Remote Supply Projects

Company	Plant Location	Origin of Liquids	Site Storage MMgal	Site Vaporization MMcf/hr
San Diego Gas & Electric Co	Moreno Springs, Calif	Peakshaving facility at Point Arena, Calif	1.0	8
San Diego Gas & Electric Co	Agua Caliente, Calif	Peakshaving facility at Point Arena, Calif	1.0	8
San Diego Gas & Electric Co	Camp Pendleton, Calif	Peakshaving facility at Point Arena, Calif	1.0	8

International Baseload LNG Liquefaction Facilities

Company and Plant Site	Liquefaction Plant Capacity MMcf/day	Storage Capacity MMcf	Storage Capacity MBbl	Type of Storage Container	Storage Contractor	Liquefaction Plant Contractor	Type of Cycle	Year of Operation
ARCTIC PILOT PROJECT Bridport Inlet Melville Island, Canada	Barge mounted	N.A.	N.A.	N.A.	N.A.	N.A.		1985
CAMEL (GL 4Z) Arzew, Algeria	1,000	1,440		Aboveground 2 x 720 MMcf Prestressed concrete				1964 (1 GL 4Z Liquefaction Train) 1972 (2nd Train)
SONATRACH (GL 1Z) Arzew, Algeria	1,000	1,440		Aboveground 2 x 720 MMcf Prestressed concrete	Technip-Geoproduction			1978
SONATRACH (GL 2Z) Arzew, Algeria	1,000	1,440		Aboveground 2 x 720 MMcf Prestressed concrete	Technip-Geoproduction			1980 (2)
SONATRACH (GL 1K) Skikda, Algeria	1,000	1,440		Aboveground 2 x 720 MMcf Prestressed concrete				1972
SONATRACH (GL 2K) Skikda, Algeria	1,000	1,440		Aboveground 2 x 720 MMcf Prestressed concrete				1981
SONATRACH (GL 3K) Skikda, Algeria	1,000	1,440		Aboveground 2 x 720 MMcf Prestressed concrete	Air Liquide			1981 (2)
ESSO LIBYA Marsa el Brega, Libya	360	1,100		Aboveground 2 x 550 MMcf Prestressed concrete				1971
BRUNEI LNG Lumut, Brunei, Borneo	1,000	1,440		Aboveground 2 x 720 MMcf Prestressed concrete				1973
ABU DHABI GAS LIQUEFACTION CO. LTD., Das Island, Abu Dhabi	1,000	1,440		Aboveground 2 x 720 MMcf Prestressed concrete				1977
ABU DHABI GAS LIQUEFACTION CO. LTD., Das Island, Abu Dhabi	1,000	1,440		Aboveground 2 x 720 MMcf Prestressed concrete				1994 Requirements for existing plant
PHILLIPS MARATHON Kenai, Alaska	1,000	1,440		Aboveground 2 x 720 MMcf Prestressed concrete				1969
PERTAMINA MOBIL Arun N. Sumatra, Indonesia	1,000	1,440		Aboveground 4 x 360 MMcf Prestressed concrete				1974
PERTAMINA HUFFCO Badak E. Kalimantan, Indonesia	1,000	1,440		Aboveground 4 x 360 MMcf Prestressed concrete				1977
PERTAMINA HUFFCO Badak E. Kalimantan, Indonesia (expansion)	1,000	1,440		Aboveground 4 x 360 MMcf Prestressed concrete	N.A.			1983 (2)
GAS DE CHILE ENAP, Gas Negro, Chile	100	N.A.	N.A.	N.A.	N.A.			1983 - Planned
MALAYSIAN LNG SDN. BHD. Bintulu, Sarawak, Malaysia	1,000	1,440		N.A. 4 x 360 MMcf Prestressed concrete	N.A.			1983 (2)
BONNY LNG Bonny, Nigeria	1,000	N.A.	N.A.	N.A.	N.A.			1986 (2) - Planned
WOODSIDE LNG PTY. LTD. Withnell Bay Western Australia	400	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	1983